REMARKS

Claims 1-9, 12-15, 17-30, 33, 38, 39, 42, 49-55, and 57-73 will be pending upon entry of the present amendment. No new matter has been added to the application.

Applicants thank the Examiner for indicating the allowability of claims 18-25, 29, 30, and 33, and of the subject matter of claims 4, 55, and 66.

Summary of Rejections Under 35 U.S.C. §§ 102 and 103

Claims 9, 38, 49, 51, 60-65, and 69-73 are rejected under 35 U.S.C. §103(a) as being unpatentable over Sato et al. (U.S. Patent 5,305,429, hereafter *Sato*) in view of Guy et al. (U.S Patent 6,879,315, hereafter *Guy*); claim 50 is rejected under 35 U.S.C. §103(a) as being unpatentable over Sato in view of Guy and Matsumoto (U.S. Patent 6,587,749); claims 12, 13, 17, 39, 42, 52, 54, and 59 are rejected under 35 U.S.C. §103(a) as being unpatentable over Sato in view of Guy and Stork et al. (U.S Patent 6,104,380, hereafter *Stork*); claim 53 is rejected under 35 U.S.C. §103(a) as being unpatentable over Sato in view of Guy, Stork, and Matsumoto; claims 1-3, 57, and 58 are rejected under 35 U.S.C. §103(a) as being unpatentable over Sato in view of Guy and Massie et al. (U.S Patent 5,587,937, hereafter *Massie*); and claims 5-8 14, 15, 26-28, 67, and 68 are rejected under 35 U.S.C. §103(a) as being unpatentable over Sato in view of Guy, Massie, and Stork.

In the discussion that follows, when a specific passage of a U.S. patent is cited, it will be indicated by a column number separated from a line number by a colon, e.g., 4:22, indicating column 4, line 22.

Claim 9 recites, in part, "a plurality of tool translation effecter devices, each having coupled thereto a second end of a respective one of the plurality of cables such that, as the attachment point moves relative to that tool translation effecter device, the cable coupled thereto is retracted or paid out accordingly, each tool translation effecter device configured to selectively vary an active tension on the cable coupled thereto and to meter the cable as it is

retracted and paid out." A combination of Guy with Sato fails to teach or suggest these limitations of claim 9. In rejecting the claim, the Office Action mailed February 3, 2009 (hereafter *Office Action*), contends that it would have been obvious to combine Sato and Guy such that "... the interface can resist, balance, or overcome a user input force ... with force being varied as a function of system conditions ...[, and that] the suggestion/motivation for doing so would have been to enhance user experience by varying haptic force felt at the attachment point as a function of system conditions." (*Office Action*, pages 3 and 4.) The Office Action also contends that a "suggestion/motivation for [the combination] would have been to provide good force transmission characteristics with low weight." (*Id.*, at page 3.)

In response to a similar rejection of claim 9 in the Office Action of June 13, 2008, Applicants' argued, *inter alia*, that: (1) such a combination is inappropriate because it would change the principle of operation of the Sato reference; (2) Sato teaches away from a combination with Guy; (3) even if it were appropriate to combine the references, such a combination would fail to teach or suggest all the limitations of claim 9. (See Applicants' amendment filed November 13, 2008.) Because these arguments are set forth in detail in Applicants' previous amendment, they will not be repeated here, but will be summarized where applicable. The remarks of the previous amendment are incorporated herein in their entirety.

With regard to the first point, Sato's principles of operation include stably supporting an *instruction point* within a three-dimensional space "without being supported by an external force" (3:30-34) through the use of weights attached at the ends of each of its four lines 14-1 to 14-4 (4:2-5), and providing feedback to a user when the instruction point encounters a virtual object in a computer-generated virtual environment by applying drag to some or all of the lines, thereby restricting movement of the instruction point in the virtual environment (6:30-47). Sato states that "to stably hold the instruction point 10 at an arbitrary point in the three-dimensional space, ... it is sufficient to attach the weights 40 to the tips of the lines 14-1 to 14-4 and to equalize the weights of the respective weights of the lines 14-1 to 14-4" (3:66-4:5). Thus, Sato teaches a simple principle of balanced counterweights to control the position of its

instruction point. This provides for Sato the advantage of eliminating all computer calculation and processing that would otherwise be required to control tensions of the lines "in accordance with the position of the instruction point," and also eliminates the additional, relatively more expensive and complex hardware, such as actuators, spools, etc., in favor of a simpler and less expensive system. To modify Sato by incorporating active control of its instruction point, as taught by Guy, would change Sato's principle of operation, and would require that Sato's simpler principle of passive position control be discarded.

Sato also provides a simplified system for providing haptic feedback. Instead of attempting to calculate feedback forces necessary to accurately represent contact with a virtual object, Sato simply applies drag to the lines to restrict their movement. In the case of contact with a hard, immovable object, "it is sufficient to completely stop the variable length operations of the lines of the variable lengths. On the contrary, in the case of a virtual object in which [some movement] is allowed, it is sufficient to reduce the degrees of limitation of the variable length operations" (6:55-60). Sato simply pinches the lines to apply drag, as "a practical method to limit the variable length operation of the lines" (6:61-7:7). Thus, Sato again teaches a simplified principle of operation, which avoids or significantly reduces computer processing required to calculate force feedback. Modification of Sato's system to provide active force feedback as taught by Guy would require a significant change of Sato's principle of operation, and would eliminate many of the advantages that Sato provides over systems like that taught by Guy.

In response to these and similar arguments, the Office Action merely states that "the combination would have been obvious for the reasons stated in the Office Action above, and … that Guy and Sato are analogous in art and Sato does not teach away from such a combination." (*Office Action*, page 21.) The Office Action has not addressed the fact that Guy's principles of operation are not the same as Sato's and that the proposed combination would change its principles of operation, discarding the principles taught by Sato. Such a combination

is "not sufficient to render the claims *prima facie* obvious."[1] (MPEP § 2143.01, VI, emphasis added.)

With regard to the second point, Sato states that "to stably hold the instruction point 10 at an arbitrary point in the three-dimensional space, strictly speaking, tensions of the lines 12-1 to 12-4 to hold the instruction point 10 must be controlled in accordance with the position of the instruction point 10. However, actually, it is sufficient to attach the weights 40 to the tips of the lines 14-1 to 14-4 and to equalize the weights of the respective weights of the lines 14-1 to 14-4" (3:66-4:5, emphasis added). Thus, Sato teaches away from controlling tensions of the lines in accordance with the position of the instruction point, which is precisely what would be required in order to vary the force as a function of system conditions, as proposed by the Office Action. Such a modification would also render Sato unsatisfactory for its stated purpose.[2]

Sato also states that "[an] object of the invention is to provide a three-dimensional input apparatus which can operate a virtual object by feeding back a drag in the case of coming into contact with a virtual object stored in a computer" (2:7-10, emphasis added). Varying the feedback force to "resist, balance, or overcome" a user input force, as a function of system conditions, as proposed in the Office Action, cannot be performed by a system that provides feedback simply by applying drag to a line, as taught by Sato. Modifying Sato to do so would defeat one of Sato's stated objects, rendering it unsatisfactory for its intended purpose.[3] Again Sato teaches away from a combination that would produce the active feedback system taught by Guy.

[1] "If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious." MPEP § 2143.01, VI.

[2] "The test for obviousness is what the combined teachings of the references would have suggested to one of ordinary skill in the art, and all teachings in the prior art must be considered to the extent that they are in analogous arts. Where the teachings of two or more prior art references conflict, the examiner must weigh the power of each reference to suggest solutions to one of ordinary skill in the art, considering the degree to which one reference might accurately discredit another.." MPEP § 2143.01, II.

[3] "If proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification." MPEP § 2143.01, V.

In response to similar arguments, the Office Action states that "Sato does not teach away from an active system merely because he discloses a passive system. Furthermore, examiner fails to find any language in Sato that suggests he expressly teaches against an active system." (*Office Action*, page 21.) Applicants respectfully disagree. Sato has not merely disclosed a passive system, but has also raised and rejected an active system. As quoted above, Sato states that "to stably hold the instruction point ..., strictly speaking, tensions of the lines 12-1 to 12-4 ... must be controlled in accordance with the position of the instruction point 10." While the term "active system" is not used here, one of ordinary skill would instantly recognize that controlling the tension on individual lines "in accordance with the position of the instruction point" is a direct reference to an active system. Sato rejects such a system by indicating that it is unnecessary, stating that, "actually, it is sufficient to attach the weights 40 to the tips of the lines ... and to equalize the weights of the respective weights of the lines ...." Furthermore, that same active system is required to provide the active feedback taught by Guy. Sato provides a drag system as a functional alternative, which it sets forth as an object of its invention. It can reasonably be argued that any modification that requires the elimination of an object of its invention would be contrary to its express teachings. Thus, Sato teaches away from an active system.

Regarding the third point, Applicants argued that neither reference teaches "a plurality of tool translation effecter devices, <u>each having coupled thereto a second end</u> of a respective one of the plurality of cables." In the case of Sato, the ends of its lines that most closely correspond to the "second ends" of claim 9 are not coupled to any device that can be considered analogous to a "translation effecter device," but are coupled to weights that hang below respective pulleys (see Figure 4). In Guy's system, the capstans are the most closely analogous elements to the translation effecter devices of claim 9. However, as with Sato, Guy's cables are not attached at an end to its capstans, as would be required to meet the language of the claim, but instead, each of the cables is attached at both ends to a rotatable element, and passes a few turns around a respective capstan in an intermediate portion of the cable (see capstans 156,

256, 356, in, respectively, Figures 2B, 2C, and 2D). Rotation of a capstan by a motor causes one end of the corresponding cable to shorten while the other end lengthens, which rotates the rotatable element, which is certainly not analogous to Sato's system, nor to the claimed invention. Thus, neither reference teaches "a plurality of tool translation effecter devices, each having coupled thereto a second end of a respective one of the plurality of cables."

The Office Action argued in response that "it is not the references individually, but rather the references taken collectively that would suggest each limitation." (*Office Action*, page 21.) Applicants respectfully disagree. If neither reference teaches or suggests a particular claim limitation, then the combination of references cannot teach or suggest that limitation. "To support the conclusion that the claimed invention is directed to obvious subject matter, either the references must expressly or impliedly suggest the claimed invention or the examiner must present a convincing line of reasoning as to why the artisan would have found the claimed invention to have been obvious in light of the teachings of the references."[4] In the present case, the combination of references does not teach or suggest all of the limitations of claim 9, and the Office Action does not provide a convincing line of reasoning as to why the claim would have been obvious in light of the combination.[5] In this respect, the Office Action states that "such a modification to arrive at the claim language, taking the references collectively, would have been within the purview of one having ordinary skill in the art." (*Office Action*, page 21.) Such a statement demonstrates that the rejection is based on hindsight analysis, rather than what the references would have suggested to one of ordinary skill in the art without the benefit of the Applicants' own teaching to serve as a blueprint.[6]

[4] MPEP § 706.02(j).

[5] The mere fact that references can be combined or modified does not render the resultant combination obvious unless the results would have been predictable to one of ordinary skill in the art. *KSR International Co. v. Teleflex Inc.*, 550 U.S. 398, 82 USPQ2d 1385, 1396 (2007).

[6] To imbue one of ordinary skill in the art with knowledge of the invention …, when no prior art reference or references of record convey or suggest that knowledge, is to fall victim to the insidious effect of a hindsight syndrome wherein that which only the inventor taught is used against its teacher. *W.L. Gore & Assoc., Inc., v. Garlock, Inc.*, 721 F.2d 1540, 1553, 220 U.S.P.Q. 303 (1983).

To the extent that the Office Action relies on a similar reasoning in a combination that includes Sato and Guy to reject independent claims 1, 12, 38, 62, and 70, such claims are also allowable for one or more of the above reasons.

Claim 1 recites, in part, "calculating means for calculating a force response to be applied to the attachment point at least in part on the basis of a position of the attachment point, as determined by a distance between each of the first, the second, the third, and the fourth tool translation effecter devices and the attachment point." In rejecting claim 1, the Office Action points to Massie as teaching the referenced limitation. Applicants strongly disagree. Massie is directed to an interface device that employs a number of mechanical linkages that are rotatably coupled together, in a manner similar to the system taught by Guy. The text cited in the Office Action as teaching or suggesting the calculating means of claim 1 (21:3-22:2) provides a very general description of a process for determining, from "the length and orientation of its various linkages, transmission ratio, etc.," (21:11-12) and applying a force to the device. However, to the extent that the text provides any specific disclosure of a process or device for making such a determination, its application is limited to mechanical devices configured like Massie's, which include arms and linkages cantilevered from a single anchor. Questions of leverage, force, relative angular positions of the linkages, etc., have no analogous application to cable-based systems. The fact that Massie's device makes such calculations does not mean that one of ordinary skill could simply adopt Massie's process with a system configured like that of Sato, for example. There is nothing in Massie's description that would enable one of ordinary skill in the art to make corresponding calculations in a system having the structure recited in claim 1, nor is there anything that would suggest that such a modification would be successful if even possible. For its part, Sato explicitly declines to undertake such calculations, choosing instead to employ a passive system with a fixed weight on each line (see 3:65-4:5). The proposed combination fails to teach or suggest the calculating means recited in claim 1. Accordingly, claim 1 is allowable on this basis, as well.

Claim 70 recites, in part, "determining respective tensions to be applied to the plurality of cables to apply an actual force vector to the tool, including balancing (1) a difference between the resulting actual force vector applied to the tool and the target force vector and (2) a magnitude of the tensions to be applied to the cables." A combination of Sato and Guy fails to teach or suggest this limitation. In rejecting claim 70, the Office Action points to Sato, 4:6-56 and 6:6-7:13, and Guy, 1:48-53, 4:55-59, and 12:64-67, as teaching or suggesting this limitation. Applicants strongly disagree. None of the cited text remotely suggests the referenced limitation.

Sato 4:6-56 discusses the determination of the position of the instruction point. It is entirely silent regarding determination of target or actual force vectors, or magnitudes of tension to be applied to the cables. Sato 6:6-7:13 discusses its method of limiting movement of its lines, i.e., "variable length operation," in which it merely stops movement of the lines, in a case where a solid, immovable object is encountered, or, where a soft or movable object is encountered, Sato explains that "it is sufficient to reduce the degrees of limitation of the variable length operations" (6:55-60). Sato again makes no attempt to determine target or actual force vectors, or magnitudes of tension, let alone teach the method as claimed.

Guy 1:48-53 makes a broad and general statement that "a degree of freedom may be powered by a motor or other actuator so that ... the interface can resist, balance, or overcome a user input force along that degree of freedom." At 4:55-59, Guy discusses the advantages of capstans and cables over mechanical linkages and gears. And at 12:64-67, Guy discusses optical encoders employed to track the location of powered axes of its device. There is no discussion in any of these passages related to the specific process for determining tensions. While the first of the passages makes reference to force applied to the interface, it is silent as to how such a force is determined. The other passages have even less relevance, being only remotely related to applied tension. Guy is entirely silent with respect to actually determining or calculating force vectors. Furthermore, even if Guy were to provide detailed instruction for determining a force vector to be applied to its device, it would be useless for combination with Sato, <u>because the respective systems are so different in their structures and principles of operation</u>. It would be unlikely that a

process set forth for determining force vectors in Guy's system could be successfully applied to Sato's system. Guy's system includes a number of elements, which are coupled in series, i.e., the first element 14 is coupled to the base 12, with respect to which it rotates at axis A, a second element 24 is coupled to element 14 and rotates around axis B, a third element 30 is coupled to the second element 24 to rotates around axis C, etc., continuing through six linked elements. Rotation of elements around any of the axes A-F results in movement of all the elements that are further out in the linkage, but no movement of elements that are closer to the base. Thus, the determination of force vectors requires consideration of the serial effect of movement at each joint on the downstream elements.

In contrast, Sato is, in a sense, a parallel system, in which each of its lines 14-1 to 14-4 is independently connected between the instruction point and a respective counter weight, and each line acts equally to affect the position of the instruction point. If Sato were capable of selectively and independently varying tension on its lines in order to apply a force vector at the instruction point, the process for determining the tensions necessary to create that vector would be entirely different from the (undisclosed) process that Guy uses for that purpose, because of their structural differences.

Finally, it cannot be assumed that the claimed method is inherent or common knowledge merely because other haptic systems – whether cable based or not – employ some undisclosed method. It would be necessary to show that the prior art process actually corresponds to the elements of the claim. Neither Sato nor Guy teaches or suggests those elements. Accordingly, claim 70 is allowable over the art of record.

While the language and scope of the claims differs, claims 67-69 and 71-73 are each allowable for reasons similar to those set forth in support of the allowability of claim 70. In particular, each claim recites elements related to the selection or determination of a force vector, which are not taught or suggested by the art of record.

In light of the above amendments and remarks, Applicants respectfully submit that all pending claims are allowable, and therefore request that the Examiner reconsider this

application and timely allow all pending claims. Examiner Beck is encouraged to contact Mr. Bennett by telephone at (206) 694-4848 to discuss the above and any other distinctions between the claims and the applied references, and to address any informalities that may remain unresolved.

The Director is authorized to charge any additional fees due by way of this Amendment, or credit any overpayment, to our Deposit Account No. 19-1090.

Respectfully submitted,

SEED Intellectual Property Law Group PLLC

/Harold H. Bennett II/
Harold H. Bennett II
Registration No. 52,404

HHB:lch

701 Fifth Avenue, Suite 5400
Seattle, Washington 98104
Phone: (206) 622-4900
Fax: (206) 682-6031

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